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(54) Apparatus for adding a display data channel to existing display

(57) Apparatus for adding a display data channel to a display device (100) comprises a memory (520) for storing display identification data. An I/O connector (104) is releasably connectable to a display output port of a personal computer for receiving display drive signals from the display output port. First communication means (501-505) transfers the display drive signals to the display device. Second communication means (Clock, Data) communicates the display identification data stored in the memory to the personal computer via the I/O connector. Power receiving means (+5V) receives electrical power to power the second communication means independently of the display device.

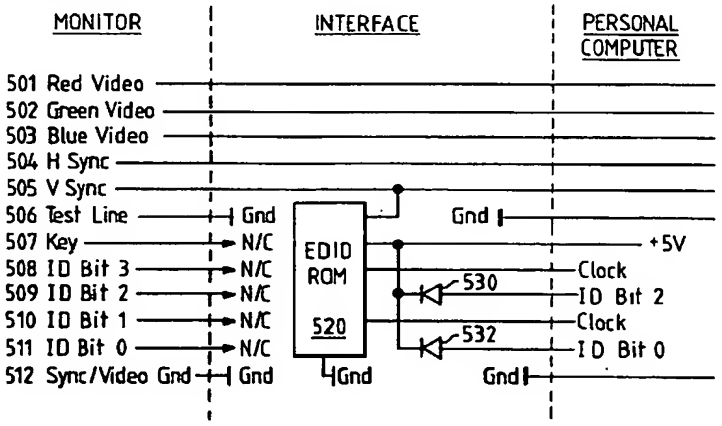

FIG. 5

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Description

Field of the Invention

The invention relates to data processing, in particular to computer monitors for use with personal computers. More specifically, the invention relates to an implementation of an interface protocol for use with existing monitors which do not themselves support that protocol.

Background of the Invention

Computer monitors in current use are connected to personal computers using an interface cable, one end of which is usually attached to the monitor internally. The interface cable has a connector at the other end, which is plugged into a mating connector, usually located on the rear of the personal computer, or on an adapter card, which is plugged into the personal computer.

Since the introduction of IBM and IBM-compatible personal computers, various different connectors have been used to connect the interface cable to the personal computer. In general, as each type of monitor requiring different interface signals has become available, a corresponding new adapter card was available to work together with the monitor as a combination. Examples of these combinations include:

The IBM Monochrome Display Adapter (MDA) and the IBM Monochrome Display, which provided 80 columns and 25 rows of alphanumeric, monochrome text;

The IBM Colour Graphics Adapter (CGA) and the Colour Graphics Display, which also provided graphics having a resolution of 640 dots by 200 dots; and

The IBM Enhanced Graphics Adapter (EGA) and Enhanced Colour Display, which provided graphics having a resolution of 640 dots by 350 dots, as well as making 64 colours available.

The EGA card could also have the Monochrome Display or Colour Graphics Display connected to it, but relied on small switches mounted on the card itself, inside the personal computer itself, to configure it for the different displays. A user of the personal computer changing the type of monitor plugged into the card had to remove the cover of the computer and change these switches.

When the IBM Video Graphics Array (VGA) and the 8514/A adapter card were introduced, a range of monitors was offered, both monochrome and colour. One of the monitors supported an additional mode, available only from the 8514/A adapter card. The other monitors did not support this mode. The mechanical connections of the monitors were common, and it was intended that any monitor should work with any adapter, without the user needing to change any switches, or answer any questions asked by an installation program. In addition, applications did not have to know whether a monochrome or colour monitor was attached, the signals provided by the VGA being adapted by the personal computer to provide readable displays on either monochrome or colour displays without user intervention.

This was achieved by the use of ID bits in the interface connector. Inside the connector attaching the monitor to the personal computer, the three ID pins were either open circuit, or connected to a ground signal. A sensing circuit in the personal computer could then determine whether a monitor was plugged in and if so, whether the monitor was monochrome or colour, and whether it supported the higher resolution capabilities of the 8514/A adapter card.

For example, ID bit 0 was grounded for a monochrome monitor, otherwise open circuit. ID bit 1 was grounded for a colour monitor, otherwise open circuit. ID bit 2 was grounded if the monitor supported the higher resolution capabilities of the 8514/A adapter card.

Later, when the number of monitor types proliferated, a fourth ID pin was added, and in addition to the pins being connected to a ground signal or open circuit, some connectors had the pins internally connected to either the vertical or horizontal synchronising signal.

With the advent of multiple mode monitors, capable of supporting more than one of these combinations, switches on the monitor, or software to manually override the auto-detected monitor type were required. Either of these solutions to the problem of identification of the monitor type connected involved the manual setting of the monitor type.

With a view to overcoming this problem, the Video Electronic Standards Association (VESA) have defined what it calls the Data Display Channel (DDC) which has as its purpose communicating, between the monitor and the personal computer or adapter card to which it is attached, what modes each can support and then deciding on the optimum mode or modes which will be used. A similar identification scheme is described in US Patent 5,276,458.

Many users have monitors which are perfectly functional and have adequate performance for the user. However they are unlikely to have the function required to support DDC. So it would be advantageous to provide an addition to those monitors to allow them to support DDC.

DDC re-assigns the pins which were previously used for monitor ID bits to provide a serial communications link having a clock and a data signal. ID bit 3 becomes a Clock signal, ID bit 1 becomes a Data signal. Power is provided from the personal computer on what was previously the Keying pin. As mentioned before, existing personal computers

and adapter conforming the VGA specification use this pin as a polarising or keying pin which is blanked off, so there is no pin to be used to provide power.

If an existing monitor is plugged into a personal computer or adapter which conforms to the DDC specification, various signals will be short circuited.

The VESA scheme does not remove existing mechanical compatibility with the interface cable plug and therefore it is to be expected that the above monitors will be attached to new DDC systems. It is also reasonable to expect that when this is done, due to the short circuits imposed, damage will result either to the monitor or the personal computer/adapter card, or both. It would therefore be advantageous to have an interface circuit that allowed a monitor to be plugged into a personal computer or adapter card which would not damage that personal computer or adapter card if the adapter card had DDC, but would nonetheless display the correct ID bits if the personal computer or adapter card only supported ID bits.

There are a number of problems with providing this function. The interface circuit for DDC needs to work regardless of whether the monitor is powered on. The solution needs to be low cost, have simple logistics and minimal changes to reduce agency approval times and costs.

Power for the interface circuit may be taken from the pin previously used for keying, but existing systems have a polarising pin in this position which is blanked off.

Power may be obtained from the monitor, but the monitor may not be powered on when the personal computer is powered on. The personal computer will not then receive any response to its requests for data from the monitor via the DDC. The personal computer will interpret this as meaning that a monitor which does not support DDC is attached. A partial solution to this problem is to provide standby power from monitor, even when the monitor is powered off.

A further disadvantage with this method is that if the personal computer is powered off and on, DDC sees a 1 to 0 transition on ID bit 3, which may cause the monitor to wait for data from the personal computer. This causes the system to hang up as monitor awaits instructions. This situation also occurs if the personal computer turns off power to the video circuits during power management. In summary, this solution only works when the monitor is powered on first, the personal computer second, the monitor is off whenever the personal computer is off, and it does not cope with personal computers having power management functions.

Disclosure of the Invention

In accordance with the present invention, there is now provided apparatus for adding a display data channel to a display device, the apparatus comprising: a memory for storing display identification data; an I/O connector releasably connectable to a display output port of a personal computer for receiving display drive signals from the display output port; first communication means for transferring the display drive signals to the display device; second communication means for communicating the display identification data stored in the memory to the personal computer via the I/O connector; and power receiving means for receiving electrical power to power the second communication means independently of the display device.

The present invention solves the aforementioned problems associated with the prior art by providing apparatus for introducing DDC capability to a display device. Because electrical power is provided to the second communication means independently of the display device, data from the memory can be read by a host personal computer via DDC even when the display device is turned off.

Preferably, the power supply means is adapted to receive electrical power from the personal computer via the I/O connector. It will however be appreciated that the power supply means may alternatively comprise a battery or similar power source.

The apparatus preferably comprises a housing containing the memory. In one preferred embodiment of the present invention, the I/O connector is remote from the housing and connected to the memory via an intermediate cable. In another preferred embodiment of present invention, the I/O connector is integral to the housing. It will be appreciated that the apparatus may be in the form of a "dongle". The dongle of the present invention advantageously enables an existing display device to be upgraded to DDC compatible display device, simply by plugging the display device into one end of the dongle and the personal computer into the other end.

In a particularly preferred embodiment of the present invention, the apparatus comprises selection means for accessing different portions of the display identification data for communication to the personal computer in dependence on one or more identification bits (ID Bit 0-3) supplied by the display device.

The first communication means may comprise an output connector releasably connectable to an interface cable of the display device. It will be appreciated that, in other embodiments of the present invention, the housing may be integral to the interface cable. This permits existing display devices to be upgraded to DDC compatible display devices simply by exchanging the existing interface cable for a cable containing apparatus of the present invention. The apparatus of the present invention thus has minimal impact to modification of existing display devices. Furthermore, the apparatus of the present invention can be made compatible with existing ID schemes and cabling.

It will be appreciated that the present invention extends to a display device comprising: a display screen; means for generating a picture on the display screen in response to display drive signals from a personal computer; and apparatus as described above for connecting the display device to the personal computer.

Brief Description of the Drawings

Embodiments of the invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 shows a computer monitor with which the present invention may be used;

Figure 2 shows a first embodiment of the invention, the module being an extension to a connector located at an end of an interface cable;

Figure 3 shows a second embodiment of the invention, the module being a box located and fixed to the interface cable;

Figure 4 shows a third embodiment of the invention, the module being a separate box interposed between the interface cable and the personal computer/adapter card;

Figure 5 is a schematic diagram of a first functional embodiment of the interface circuit contained in the modules of either figure 1 or figure 2; and

Figure 6 is a schematic diagram of a second functional embodiment of the interface circuit contained in the modules of either figure 1 or figure 2.

Detailed Description of the Invention

A commonly used concept when applied to serial communications links etc. is to provide what is called a "dongle", or an interface module that is placed between two ends of a communications link. Such a dongle may carry out the function of a translation of dat, change in interface characteristics such as voltage levels, or may be more intelligent and contain a small amount of processing power. In the present invention, the dongle is used to "fool" the personal computer/adapter card into believing that a monitor fully supporting DDC is connected to it. The monitor is "fooled" into thinking that it is connected to an existing type of personal computer/adapter card. In this way damage to either piece of equipment is avoided and compatibility is also achieved.

Two mechanical embodiments of the interface module will now be described. The electrical characteristics of the circuitry contained within the interface module will be described later with reference to figure 3.

Figure 1 shows a computer monitor 100 with which the present invention may be used. The monitor includes an interface cable assembly 102 having at the end furthest from the monitor a connector 104 for connection to a personal computer or adapter card.

Figure 2 shows a first embodiment of the interface module, in which the connector 104 is enlarged to form a connector assembly 202 to take a circuit card, or a flexible circuit substrate containing the interface circuit (described later). This embodiment results in a very compact implementation of the interface module and allows use of existing types of bulk interface cable.

Figure 3 shows a second embodiment of the interface circuit. An interface cable assembly 300 comprises a cable 102 which is connected to the monitor at a first end. A small box 302 containing the interface circuitry forms the module, and is mounted on the interface cable 102, such that the interface cable 102 from the monitor enters the box 302 at a first end 304 and exits at a second end 306. Connections are made from the interface cable 102 to the interface circuitry contained within the box 302. This embodiment takes up a minimum of space at the rear of the personal computer/adapter card and allows a standard style of connector to be used to attach to the personal computer/adapter card.

Figure 4 shows a third embodiment of the interface circuit. A separate module 400 is used and the existing display interface cable connector 104 plugs into a first end of the module. The second end of the module plugs into the personal computer/adapter card. The interface circuit is contained within the module. This embodiment may be used as an upgrade to existing standard monitors without any internal modification.

Figure 5 shows a schematic diagram of an interface circuit, suitable for use between a monitor and a personal computer/adapter card to solve this problem. The function of two functional embodiments of the interface circuit will be described.

Video signals for the Red, Green and Blue channels 501, 502, 503, and Horizontal synchronising signal 504 pass through the interface circuit unchanged and are not used in any way by the interface circuit. Vertical synchronising signal

505 and the ground signal 512 pass through the interface circuit unchanged, but are used by the interface circuit. The test line 506, which is an input to the monitor, is grounded, so that the monitor believes that it is connected to a personal computer/adapter and does not operate in a test mode. The key pin 507 has no connection.

In a first embodiment of the functional aspects of the circuit, ID bits 0 through 3, (508, 509, 510, 511) from the monitor are not connected, the identification data for the particular monitor being predetermined within the Read Only Memory (ROM) contained in the interface circuit. Different part numbers of interface circuit are used for monitors having different identification information.

A second functional embodiment of the functional aspects of the circuit is shown in figure 6. ID bits 0 through 3, from the monitor (508, 509, 510, 511) are connected to the circuit, the identification data for the particular monitor being determined by the 4 bit ID obtained from the ID bits and then translated into the relevant data to be sent to the personal computer/adapter card. The 4 bit ID may be used as an offset into the data contained in the ROM, thus determining which of the multiple sets of data stored in the ROM is communicated to the personal computer/adapter card. The special cases of ID bits 2 and 3 having a synchronisation signal present can be handled by a suitable monostable circuit detecting the transitions in the sync signal and providing an additional one or more address bits.

The Extended Display Identification Data (EDID) circuit 520 contains a ROM, which has the information necessary to describe the monitor to the personal computer/adapter card. The EDID requires the following signals:

- o Ground
- o +5v power (this is from either or both of ID bits 0 and 2, and optionally from the monitor via the interface cable).
- o ID Bit 3 from the personal computer/adapter card (used as a clock line)
- o ID Bit 1 from the personal commuter/adapter card (used as a data line)
- o Vertical Sync

The ground connection is used by the EDID circuit as a power and a signal ground. Power is preferably drawn from the personal computer/adapter card via the ID bit 0 and/or the ID bit 2 connections. In the personal computer/adapter card, these are connected through pull-up resistors, typically of value 1kOhm to a +5v supply. Diodes 530 and 532 are used to power the circuit from either or both of these ID bits. Because of the low power consumption of the interface circuit, the voltage drop across the 1kOhm resistors does not affect operation of the circuit. Optionally, an additional, or a replacement, power connection may be made to a supply from the monitor. Use of ID bits 0 and 2 to supply power has the advantage that the monitor timing data will be available even if the monitor has no power applied (or indeed not even connected!). This is actually an advantage over a "proper" DDC implementation with the ROM and interface circuit contained within the monitor. As mentioned above, power may optionally be supplied from the monitor via the interface cable. Power does not need to be supplied from the adaptor card using the means mentioned above.

In a first mode of operation, called DDC1 by VESA, the circuit continually sends 128 bytes of information, containing details about the capability of the monitor, to the personal computer/adapter card using ID bit 1 as a data line, and the Vertical Sync line as a clock line.

In a second mode of operation, called DDC2B by VESA, the clock and data signals are used by circuits in the personal computer/adapter card to retrieve information from the ROM concerning the description of modes supported by the monitor. Examples of the mode description information can be found in table 1 below. Note that DPMS stands

for Display Power Management Signalling.

Monitor Type	Mode Description
6091	1280x1024 @ 60Hz & 67 Hz Non-interlaced
9517	640x480 @ 75Hz, 1024x768 @ 72Hz, 1360x1024 @ 103Hz Interlaced
8503, 8504	640x480 @ 60Hz, monochrome
632X, 9524/5	64kHz, Multisync with DPMS
9521/27	82kHz, Multisync with DPMS

Table 1. Examples of Mode Descriptions for monitors

In an optional third mode of operation, called DDC2AB by VESA, there is bi-directional communication between the personal computer/adapter card and the monitor. This allows, for example, the personal computer keyboard to be plugged into the monitor and keystroke data transferred from the monitor via the interface circuit. It also allows for access by the personal computer/adapter card to controls inside the monitor for the adjustment of, for example, image size and shape.

Either of the embodiments of the functional aspects of the circuit may be extended to include other information from the monitor, such as its serial number, date of manufacture etc.

Claims

1. Apparatus for adding a display data channel to a display device (100), the apparatus comprising: a memory (520) for storing display identification data; an I/O connector (104) releasably connectable to a display output port of a personal computer for receiving display drive signals from the display output port; first communication means (501-505) for transferring the display drive signals to the display device; second communication means (Clock, Data) for communicating the display identification data stored in the memory to the personal computer via the I/O connector; and power receiving means (+5V) for receiving electrical power to power the second communication means independently of the display device.

2. Apparatus as claimed in claim 1, wherein the power supply means is adapted to receive electrical power from the personal computer via the I/O connector.

3. Apparatus as claimed in claim 1 or claim 2, comprising a housing (202;302;400) containing the memory.

4. Apparatus as claimed in claim 3, wherein the I/O connector is remote from the housing (302) and connected to the memory via an intermediate cable.

5. Apparatus as claimed in claim 3, wherein the I/O connector is integral to the housing (202;400).

6. Apparatus as claimed in any preceding claim, comprising selection means (508-511) for accessing different portions of the display identification data for communication to the personal computer in dependence on one or more identification bits (ID Bit 0-3) supplied by the display device.

7. Apparatus as claimed in any preceding claim, wherein the first communication means comprises an output connector releasably connectable to an interface cable (102) of the display device.

8. Apparatus as claimed in claim 7, in the form of a dongle.

9. Apparatus substantially as hereinbefore described with reference to Figures 2, 3, 4, 5, or 6 of the accompanying drawings.

10. A display device comprising: a display screen; means for generating a picture on the display screen in response to display drive signals from a personal computer; and apparatus as claimed in any preceding claim for connecting the display device to the personal computer.

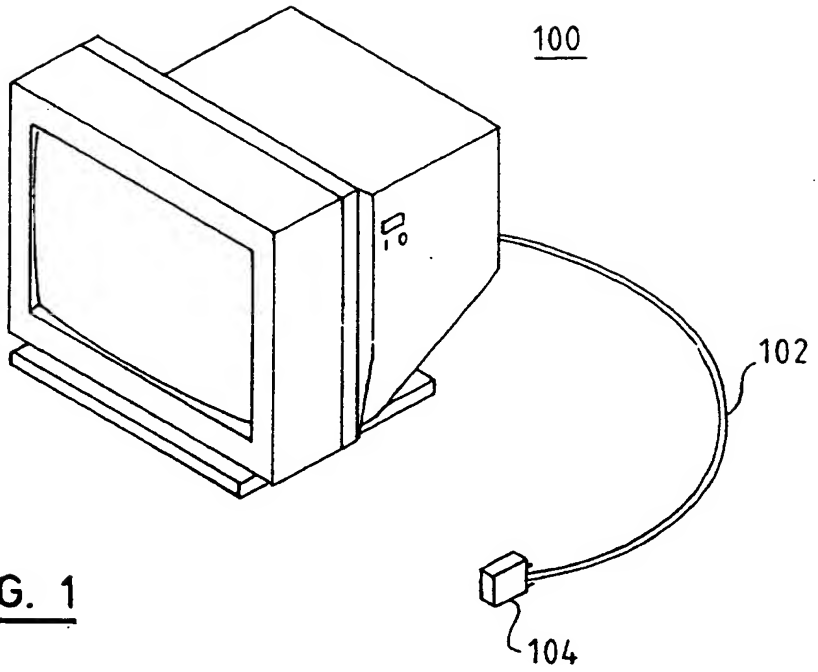

FIG. 1

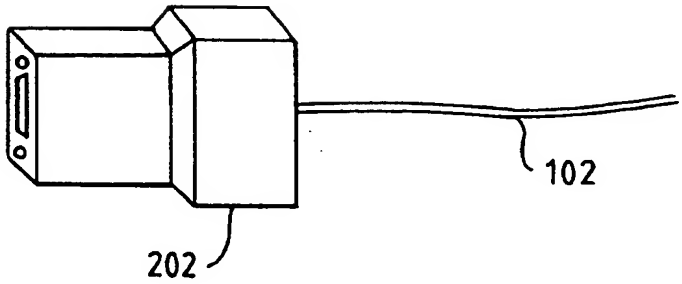

FIG. 2

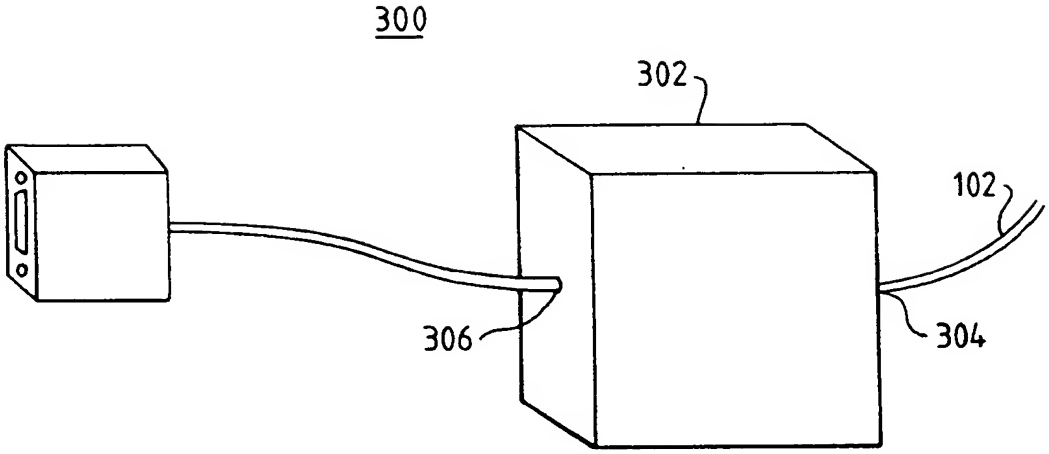

FIG. 3

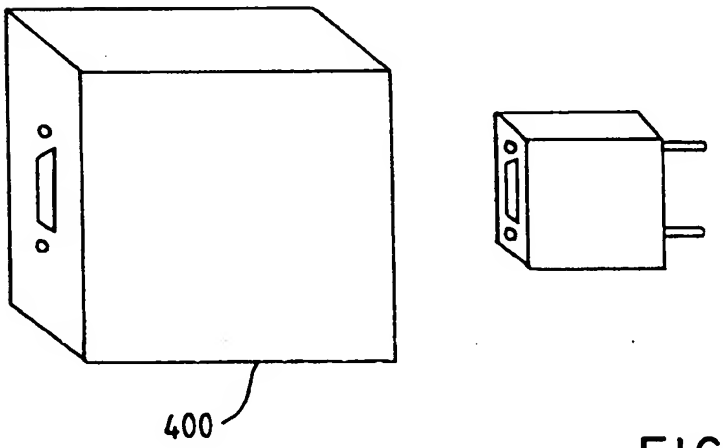

FIG. 4

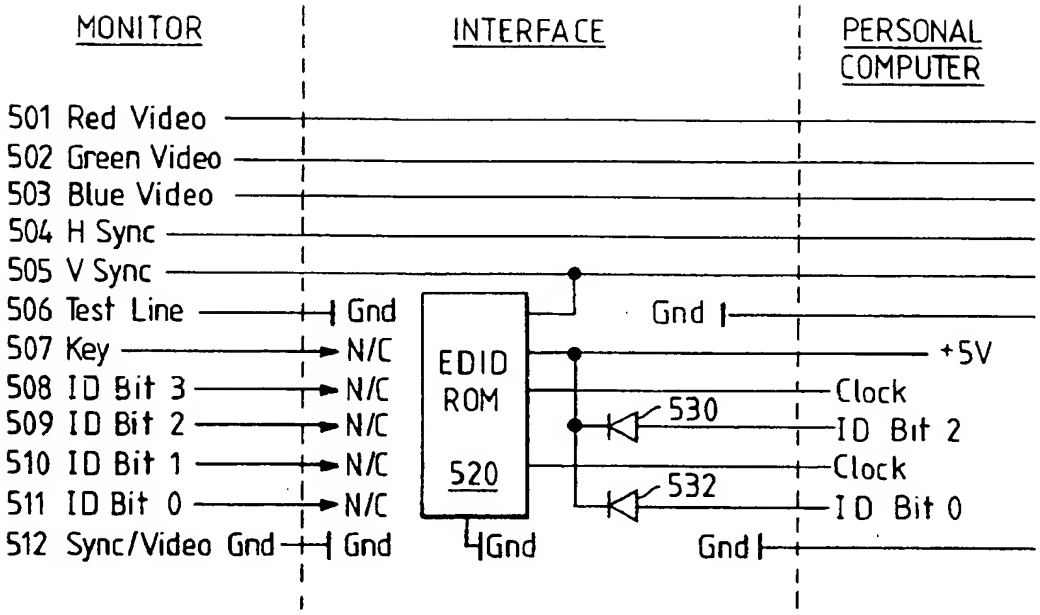
MONITOR
INTERFACE
PERSONAL COMPUTER
501 Red Video
502 Green Video
503 Blue Video
504 H Sync
505 V Sync
506 Test Line
507 Key
508 ID Bit 3
509 ID Bit 2
510 ID Bit 1
511 ID Bit 0
512 Sync/Video Gnd
Gnd
N/C
N/C
N/C
N/C
Gnd
EDID ROM
520
Gnd
Gnd
Gnd
+5V
Clock
530
ID Bit 2
Clock
532
ID Bit 0
Gnd

FIG. 5

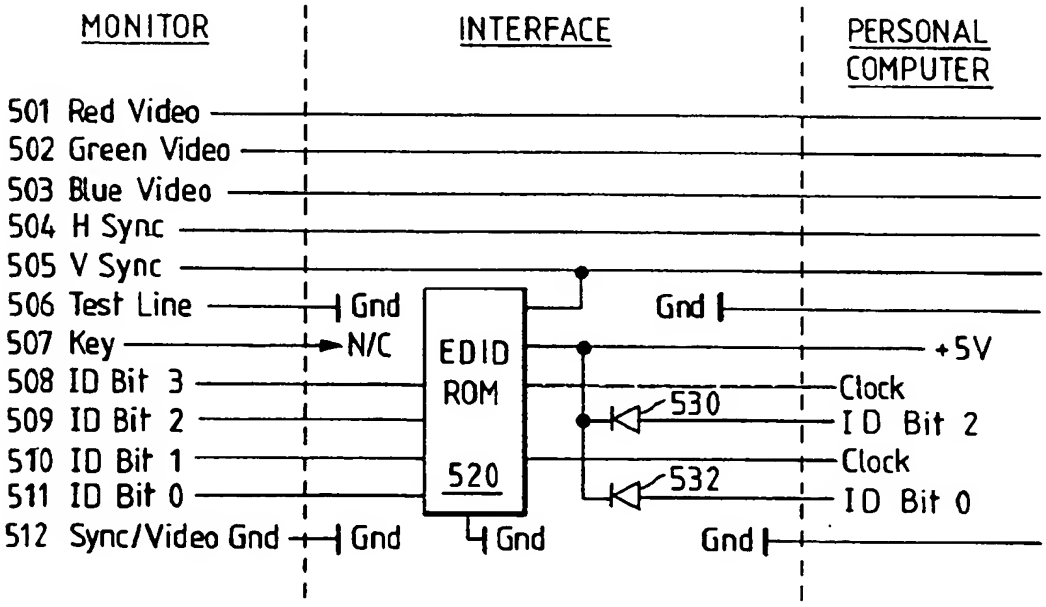
MONITOR
INTERFACE
PERSONAL COMPUTER
501 Red Video
502 Green Video
503 Blue Video
504 H Sync
505 V Sync
506 Test Line
507 Key
508 ID Bit 3
509 ID Bit 2
510 ID Bit 1
511 ID Bit 0
512 Sync/Video Gnd
Gnd
N/C
Gnd
EDID ROM
520
Gnd
Gnd
+5V
Clock
530
ID Bit 2
Clock
532
ID Bit 0
Gnd

FIG. 6